

A Cost-Efficient Microfluidic Device for Study of Chemotaxis and Bacteria Separation Purposes

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Abstract

We present a novel microfluidic device for the study of bacterial chemotaxis. The device uses widely available nitrocellulose membranes (Milipore Inc.) as the permeable layer for generation of a chemical gradient. Low cost fabrication methods, combined with significant flexibility in the design of channels / chambers, provide a useful platform for laboratory experiments. The device could potentially be utilized for separation of bacteria during the detection and evaluation of pathogen viability.

The microfluidic device consists of a main channel into which the bacteria sample was loaded. The side channel serves as a source for generating a chemical gradient in the center chamber. A porous media separates the channels from each other, while allowing diffusion between them. This design was implemented using Millipore nitrocellulose membranes with 0.45 μm pore size and 120 μm thickness. This type of membranes is also available in a range of pore sizes for different applications.

The channels are cut in the membrane using a precise laser cutter tool. The membrane layer that includes channel cut was then sandwiched between two microscope slides. The bottom slide is a regular 1 mm thick microscope slide, the top slide is similar but includes holes for input and output flow ports. Small cylindrical pieces are attached to the top glass slide to serve as small fluid reservoirs. Response of *E. coli* to a range of chemo-attractant/chemo-repellent gradients was observed.

Generation of quasi-steady state chemical gradient was confirmed in the microfluidic chambers by diffusion of fluorescein dye, which has a similar diffusivity to other small molecules, such as glucose. Figure 3 shows measured fluorescence intensity profile in the chamber.

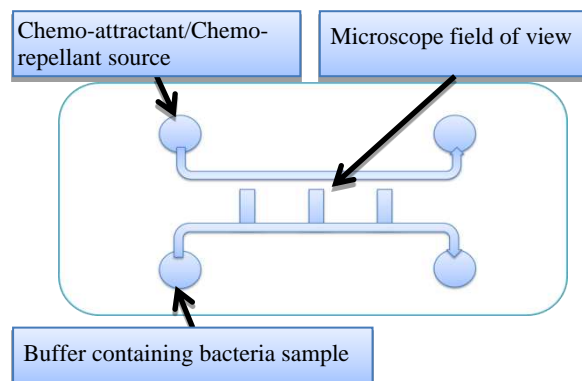


Figure 1 Schematic of the chemotaxis device, the channels are 120 μm thick and 800 μm wide, center chambers are about 3 mm in length.

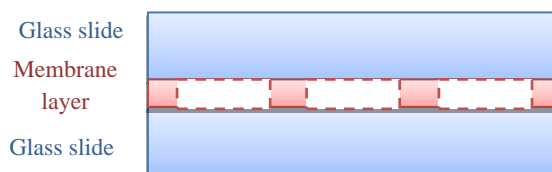


Figure 2 A cross section showing assembly of the device.

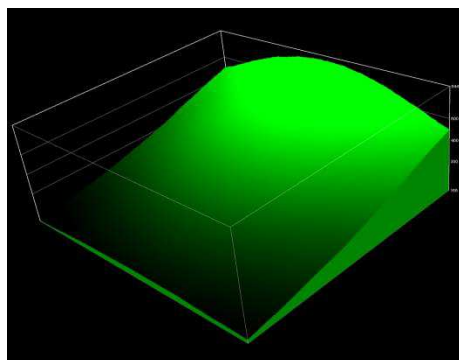


Figure 3 Intensity of fluorescence light over a chamber area.